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## PHYSIOGRAPHIC NOTES.

BY

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AGE OF THE EARTH.—Although the paper will be widely distributed and commented upon, it seems desirable to call especial attention in this place to the Presidential address of Sir Archibald Geikie before the last meeting of the British Association for the Advancement of Science. It is one of the fairest and most convincing statements concerning our knowledge of the age of the earth that has yet appeared. After calling attention to the doctrine of the great age of the earth, early proposed by Hutton and more fully elaborated by Lyell and his followers, he notes the fact that physicists, especially Lord Kelvin, have argued against the geological conclusions on the basis of physical deductions. Geikie states that geologists have considered carefully the arguments of the physicists, and even revised their chronology, but have not been able to accept in full the conclusions of the workers in physics. He shows, too, that even physicists, notably Prof. Perry, are not agreed as to the fundamental arguments upon which Kelvin's conclusions of brief earth history have been based.

In contrast to the readiness of geologists to study with care the physical arguments, and, if necessary, to revise conclusions, Geikie calls attention to the fact that

Lord Kelvin has never taken any notice of the strong body of evidence adduced by geologists and palæontologists in favour of a much longer antiquity than he is now disposed to allow for the age of the earth. His own three physical arguments have been successively re-stated with such corrections and modifications as he has found to be necessary, and no doubt further alterations are in store for them. He has cut off slice after slice from the allowance of time which at first he was prepared to grant for the evolution of geological history, his latest pronouncement being that it was more than twenty and less than forty million years, and probably much nearer twenty than forty. But in none of his papers is there an admission that geology and palæontology, though they have again and again raised their voices in protest, have anything to say in the matter that is worthy of consideration.

Geikie then restates with brevity some of the important geological arguments in favor of the great antiquity of the earth. In this connection he says:

So cogent do these geological and palæontological arguments appear, to those at least who have taken the trouble to master them, that they are worthy of being em-

ployed, not in defence merely, but in attack. It seems to me that they may be used with effect in assailing the stronghold of speculation and assumption in which our physical friends have ensconced themselves, and from which, with their feet, as they believe, planted well within the interior of the globe, and their heads in the heart of the sun, they view with complete unconcern the effort made by those who endeavour to gather the truth from the surface and crust of the earth.

Geikie concludes:

So far as I have been able to form an opinion, one hundred millions of years would suffice for that portion of the history which is registered in the stratified rocks of the crust. But if the palæontologists find such a period too narrow for their requirements, I can see no reason on the geological side why they should not be at liberty to enlarge it as far as they may find to be needful for the evolution of organized existence on the globe.

While demanding attention to the geological arguments, which seem to him, as to most geological students, certainly as worthy of attention as the physical arguments based upon broad assumptions, possibly incorrect, he calls attention strongly to the fact that one of the needs of geology at present is more detailed studies with numerical results. There is a necessity of knowing the rate of progress of certain agencies that are at present at work upon the earth, and Geikie very properly draws attention to this need. Experimental geology along these lines offers one of the great fields for the investigator at present.

THE ORIGIN OF LOESS.—The remarkable deposit of fine, loamy loess which is found in parts of Europe, America and Asia has been much discussed as to origin. A recent paper in Russian, entitled, "Upon the Question as to the Mode of Formation of Loess" (Reprint from *Zemlovedenie*, Moscow, 1899), by Paul Toutkowsky, is an interesting addition to the literature. He points out that the loess of Europe and North America is connected with the glacial period, and that there is no pre-glacial loess, the deposit evidently having intimate connection with the retreat of the glacier; then asks the questions: How were these deposits brought? Why did they cease at the close of the glacial epoch? and Why is no loess found north of a definite boundary?

Among the theories for the formation of loess, one that has taken prominent rank is that advocated by Richthofen for China, namely, the action of dry winds in blowing dust about. This Toutkowsky proposes to apply to the loess associated in origin with the continental glaciers. Considering the probable meteorological conditions during the Ice Age, he concludes that the isobars were concentric over these great glaciers, so that the gradients consti-

tuted a large anticyclonic system over which the air moved downward to the periphery of the ice-sheet. Such winds, coming down grade, became warmed by dynamic heat, much as the foehn of Switzerland or the chinook of western America is warmed as it passes down the mountain slopes. Similar winds are noticeable in Greenland, though, owing to the much smaller area occupied by the ice, they are much less pronounced than this assumed set of glacial winds.

The glacial period foehn-winds swept with such vigor from the interior, especially in spring and summer, that they extended well beyond the limits of the ice margin. They passed over a zone from which the ice was retreating and upon which there was little or no vegetation, and drying the earth, as the foehn dries the soil of Switzerland, whirled the dust along and built the loess deposits. There were, then, desert tracts near the ice margin, forming vast continental steppes, covered by grass, and inhabited by mammalia and mollusca, land-forms for the most part, although lacustrine along the shores of lakes.

Numerous geological and geographical facts seem to corroborate this view, and the author believes that the fine, unstratified deposit containing the fossil fauna of the Russian steppes, together with traces of palæolithic man, had its origin in this cause. As the ice-front withdrew northward, the desert zone likewise shifted to the northward, and the loess was blown from it out over the region from which the ice had only recently retreated.

Finally the ice margin retreated so far that the foehns became feebler and feebler as the area of ice diminished; and, moreover, its periphery had gone so far northward as to uncover great seas, like the Baltic, and the ice-dammed lakes of North America, so that the foehn was not only weaker but less dry, and at last extensive loess deposits ceased to be produced.

From this consideration of the subject, Toutkowski concludes that loess, like moraines or erratic blocks, is a testimony of the former presence of the glacier, though a witness of its death agony rather than its life and power, as the moraine is. He says that

the great problem, how from the chaos and ruin sprung the blooming prairie; how from the cold realm of death a new, vigorous, gushing life was born, this seems to me solved and completely clarified by this new light.

It seems that Toutkowski's discussion is well worthy of careful consideration, and that he may have come upon the true explanation of much loess, although there are some deposits of so-called loess which seem to be definitely associated with stream action.

There is, however, no reason why both kinds might not have been produced at the same time. It is interesting in this connection to note the independent evidence of this origin of loess produced by Woodworth in his brief remarks concerning the desert conditions in New England, quoted in the abstract of his paper given below.

WASH-PLAINS.—One of the most interesting classes of deposits connected with the presence of the American glacier is the set of plains which have been produced by gravel-laden streams emerging from the ice-front. Various names have been applied to the different modifications of this class of plain, such as sandplain, overwash-plain, etc. In an exceedingly important paper, Woodworth (*Bulletin, Essex Institute*, XXIX, 1897, 71-119) groups the several classes together under the name of wash-plains. A considerable portion of the paper is devoted to a detailed description of certain areas of these deposits in southern New England; but, aside from these points of mere local interest, the general problem itself is discussed in a masterful manner.

Concerning the origin of wash-plains, Woodworth says:

The attempt, therefore, to interpret sea-level by a rigid application of the criterion of wash-plain level involves us in hopeless inconsistency, sudden changes of level, and the need of having the sea at different levels at the same time in the same region.

If the water-level index afforded by delta-fronts means anything at all, it seems to point to local bodies of water standing at levels dependent on local topographic conditions, as in temporary glacial lakes or flooded areas.

This view, of course, does not exclude the possibility of certain low-lying plains near the coast being deposited under the marine limit.

Another interesting conclusion of broad scope is that the ice-sheet was not lying stagnant over the area during the formation of the wash-plains, but that

there were periods of marginal inactivity, accompanied by the tunnelling of running water, esker-building, terrace and plain construction, with a general retreat of the main front, followed by seasons of advance, with the shoving of drift deposits, the spreading of till and boulders over wash-plains.

Covering the wash-plains in places, as previously pointed out by Davis and Woodworth, is a fine loamy sand, resembling loess, embedded in which are pebbles, grooved as by a sand-blast and located in a region where now no sand is blowing, which

makes it highly probable that immediately after the ice retreated, and before vegetation came in, the barren, sandy stretches were for a time in a desert condition.

Woodworth points out the importance of these wash-plains in the settlement of the region. Being flat lands, free of boulders,

they were easily cleared, and consequently quickly transferred to farming land; while upon the flat spaces of the wash-plains the greater number of towns and villages of southern New England are built. The sands and gravels have also had a decided influence upon drainage and local water supply, besides furnishing suburbs of cities and the towns with an almost inexhaustible source of gravel and sand for use in the construction of masonry and walks.

PHYSIOGRAPHY OF MARYLAND.—As a dissertation for the Doctor's degree at Johns Hopkins, Cleveland Abbe, Jr., has published the best account of the physiography of Maryland that has yet appeared (Report of Maryland State Weather Service, Vol. I, 1899, pages 41-216). The paper commences with a general treatment of basal physiographic principles, somewhat elementary and very interesting, and upon this builds up a treatment of the physiography of the State which is excellent. Naturally, a great deal of attention is paid to the rivers and their work—perhaps an unduly large share of attention, although the coast lines and mountain forms are not entirely neglected.

This paper will commend itself to all interested in physiography in general, or in the geography of Maryland. Many individual instances of physiographic form and process are given, some of which have general application. One of the most important generalizations of the paper is the conclusion that the streams of the eastern division of the Piedmont plateau have been given their courses, which extend with marked disregard to rock structure, by reason of the fact that they started upon a surface of coastal plains which have since been almost entirely removed. That is, they are superimposed streams. This conclusion is interesting, not alone from its bearing on the history of stream development, but as showing the possible extension of physiographic work into the interpretation of ancient stratigraphy when all other evidence of the former existence of beds has been destroyed. By employing the method adopted by Abbe, one may be able to explain some of the characteristics of the Piedmont plateau of the more southern States, which it is now the fashion to explain on the basis of peneplanation.